A six-month follow-up study in comparison of complications of arteriovenous fistula with permanent catheter in hemodialysis patients at a tertiary care unit

[1]Dr.Vajed Mogal, [2]Dr. Kshitija G Gadekar, [3]Dr.S.G. Kulkarni, [4]Dr. Ankit Data

[1]DM Nephrology, Assistant Professor, Department of nephrology, MGM Medical College, Aurangabad, Maharashtra, India
[2]DM, Department of nephrology, MGM Medical College, Aurangabad, Maharashtra, India
[3]DM, Department of nephrology, MGM Medical College, Aurangabad, Maharashtra, India
[4]DM, Department of Nephrology, MGM Medical College, Aurangabad, Maharashtra, India

Correspondence:
Dr. Vajed Mogal
DM Nephrology, Assistant Professor, Department of nephrology, MGM Medical College, Aurangabad, Maharashtra, India
Email: drvajedmogal@gmail.com

Abstract

Introduction: Arteriovenous fistula (AVF), permanent catheter (PC), and vascular graft are three vascular access types used for hemodialysis (HD) procedure. Due to insufficient reliable information on the comparison between AVF and PC. This study was conducted to compare AVF and PC regarding adequacy of dialysis.

Material and Methods: This prospective study was carried out in tertiary care center over 6 months (Jan 2021 to June 2021). In this study, 100 HD pts were enrolled and assigned to two unequal groups of AVF and PC. Before and after the dialysis session, blood samples were taken for laboratory examinations and measurement of urea reduction ratio and Kt/V. The patients were followed up for six months, and then laboratory examinations were repeated.

Results: Out Of the 100 HD pts, 40 had AVF and 60 patients on PC. During the 6-month follow-up, 30 patients in PC group but only two patient in AVF group showed infection (P = 0.050), while in each group, thrombosis were seen in 6 patients on PC and 4 patients of AVF (P = 0.50). Catheter dysfunction was seen in 15 patients of PC group and one patients of AVF group (P = 0.0001).There was no difference between the two groups in Kt/V and URR at the beginning of the study; however, after six months, Kt/V and URR were greater in AVF group (P< 0.05).

Conclusion: We found better dialysis adequacy in AVF group & there were some advantages of AVF over PC, such as lower rate of infection and thrombosis. We recommend that AVF be created in all of patients with chronic kidney disease who are candidates for HD.

Keywords: Chronic kidney disease, Hemodialysis, Arteriovenous fistula.

Introduction

Chronic Kidney Disease (CKD) is a condition in which there is heterogenous disorders affecting kidney function and structures that encompasses degree of decreased renal functions.Chronic kidney disease (CKD) is a common and serious disease worldwide. CKD can lead to end-stage renal disease. Hemodialysis is indeed the most common type of renal replacement therapy in many countries, and therefore vascular accesses including arteriovenous fistula (AVF), intravascular catheters, and vascular grafts (VGs) are essential to conduct hemodialysis procedure.[1]In addition, AVF is preferred over the other hemodialysis

accesses because of lower risk of infection and thrombosis.[2,3]Longer access survival rate, shorter hospitalization, and less mortality and morbidity have been reported in patients with AVF, as well.[4]

However, in some cases such as diabetes mellitus, heart failure, peripheral vascular disease, obesity or elderly patients, insertion of AVF is difficult or contraindicated, therefore in these patients, insertion of tunneled cuff catheters may be the preferred method.[5-7] The most serious and life-threatening complication of permanent catheters (PCs) is infection.[8] Due to insufficient reliable information on the comparison between AVF and PC. This study was conducted to compare AVF and PC regarding adequacy of dialysis.

Material and Methods

This prospective study was carried out in tertiary care center. In this study, 100 hemodialysis patients were enrolled and assigned to two unequal groups of AVF and PC care center over 6 months (Jan 2021 to June 2021).

The inclusion criteria were age >18 years and dialysis duration of at least six months. The exclusion criteria were non-cooperation of the patients or change of dialysis access, such as a change to PC from AVF and vice versa during the study.

At the end of hemodialysis session, blood flow rate decreased to 50 ml/min, and blood samples were taken to measure urea reduction ratio (URR) and Kt/V. The patients were followed up for six months, and then laboratory examinations were repeated at the completion of follow-up. All parameters were described as mean ± standard deviation and P <0.05 was considered statistically significant. All information and data were kept confidential, and informed consent was provided by the patients to take samples at enrollment.

Results

Out of the 100 hemodialysis patients, 40 had AVF and 60 patients on PC. There was no significant difference between the two groups of the patients in body mass index (BMI) and number of dialysis sessions per week; however, duration of dialysis (year) in AVF group was greater than PC group (Table 1).

During the 6-month follow-up, 30 patients in PC group but only two patient in AVF group showed infection (P = 0.050), while in each group, thrombosis were seen in 6 patients on PC and 4 patients of AVF (P = 0.50). Catheter dysfunction was seen in 15 patients of PC group and no patient of AVF group (P = 0.005). (Table 2)

There was also no significant difference between the two groups in Kt/V (P=0.03) and URR (P=0.23) at the beginning of the study; however, after six months, Kt/V (P=0.03) and URR (P=0.02) were greater in AVF group. There was also no significant difference between the two groups of the patients in different laboratory parameters at the beginning of the study or six months later(Table3).

Table 1: Demographic characteristics of patients

Variables	Type of access	Mean ± SD	P value
Age (years)	PC	42.90 ± 14.15	0.52
	AVF	40.84 ± 15.98	
BMI (Kg/m^2)	PC	19.60± 3.97	0.99
	AVF	21.40 ± 5.39	
Duration of dialysis (year)	PC	2.63 ± 2.05	0.001
	AVF	5.40 ± 4.82	
Number of dialysis per week	PC	2.49 ± 0.42	0.089
	AVF	2.67 ± 0.38	

Table 2: Comparison of complications in two groups of the patients in the beginning and after six months follow-up:

	AV Fistula Group	Perm Cath Group	Total	P value
Infection	02	30	32	0.050
Non-Infection	48	20	68	
Total	50	50	100	
Thrombosis	04	06	10	0.50
Non-Thrombosis	46	44	90	
Total	50	50	100	
Catheter dysfunction	01	15	15	0.005
Non-Catheter dysfunction	49	35	85	
Total	50	50	100	

Table 3: Comparison of laboratory parameters / variables in two groups of the patients in the beginning and after six months follow-up:

Time	Group	Hb	S.Cr	Ca	P	UA	Alb	Bicarb	URR	Kt/V
Before	AVF	8.01 ± 1.24	7.64 ± 1.86	8.44 ± 0.39	4.62 ±1.29	5.70 ± 1.64	3.17 ± 0.41	20.60 ±2.12	0.71±0 .04	1.54 ±0.21
	PC	7.64 ± 0.92	8.25 ± 2.03	8.39 ± 0.43	4.60 ±1.20	5.63 ± 1.89	3.21 ± 0.38	20.45 ±2.02	0.70 ±0.04	1.47 ±0.18
p-value		0.10	0.14	0.55	0.96	0.86	0.63	0.74	0.23	0.09
After	AVF	7.90 ± 1.16	7.83 ± 1.93	8.43 ± 0.40	4.62 ±1.26	5.68 ± 1.71	3.19 ± 0.40	20.56± 2.08	0.71 ±0.04	1.51 ±0.20
	PC	8.42 ± 1.02	8.14 ± 2.02	8.20 ± 0.37	4.39 ±1.13	5.32 ± 1.43	3.23 ± 0.41	20.10 ±2.05	0.67 ±0.06	1.37± 0.29
p-value		0.13	0.13	0.51	0.87	0.81	0.64	0.72	0.02	0.03

Discussion

The study showed that AVF was superior to PC in termsof lower frequency of thrombosis, access dysfunction,infection, and dialysis adequacy (Kt/V and URR).There are many studies on comparison of the AVF, PCand VG. Moyano *et al.* showed fewercomplications in PC than VGs in hemodialysis patients; however, the main cause of failure could be thrombosis andinfection in both methods.[9]

In a study on hemodialysispatients with PC, Moist *et al.* found that blood flowrate <300 ml/min was not commonly an indication fordialysis inadequacy, therefore other predisposing factorsshould be kept in mind as well.[10]Tonelli*et al.* in a study on 53 hemodialysis patients, afterthree weeks of follow-up, concluded that adequate Kt/Vwas achieved in AVF and PC groups but the surprisinglytime of prescribed dialysis was higher in the AVF group.However, in this study, AVF was superior regardingdialysis adequacy; therefore it seems that inconsistency inthe results of above studies may be due to different samplesize or difference in duration of follow-up.[11]

Hicks *et al.* reported that AVF wassuperior to VG and PC regardless of the patient's age.

In contrast, VG may be superior to PC in the patientsaged >48 or <18 years.[12] Karkar *et al.* in astudy on 358 hemodialysis patients reported decrease ininfection and thrombosis, increase in average blood flow,improvement of average single pool Kt/V, increase inhemoglobin, improvement of serum albumin, reduction inadministered erythropoietin dose, and significant

decline in hospitalization. They concluded that AVF was superiorto PC in terms of the quality of hemodialysis and patientoutcome.[13]

Canaud *et al*. conducted a study on 42 hemodialysis patients in two periods of 12 months each. During the first 12-monthperiod, hemodialysis was continued with PC and thenAVF inserted for additional 12 months. They concludedthat dialysis adequacy (measured by Kt/V) was slightlylower in PC compared to AVF; therefore, they offeredlonger dialysis sessions for patients with PC. Moreover, Canaud *et al.* carried out a study on hemodialysis patientswith temporary catheter (TC), PC, and AVF, and found thatdialysis adequacy and mean blood flow were greater in PCcompared to TC and greatest in patients with AVF.[14]

Ethier *et al*. in a multicenter study in some countries showed thatin hemodialysis patients with AVF, dialysis adequacy washigher than patients with PC; in addition, they concludedthat after AVF, preferred vascular access was VG.[15]

Canaud *et al*. in a study on hemodialysis patient's showedthat PC is an excellent access with low frequency ofcomplications for elderly patients.[16] Lee *et al*., in a studyabout the comparison between AVF and grafts, reporteda higher primary failure rate, longer catheter dependence, and more frequent catheter-related bacteremia in the fistula.[17]

Banerjee *et al.* in a study on583 hemodialysis patients showed greater inflammationand mortality in hemodialysis patients with PC comparedto AVF, and therefore recommended the early removalor avoidance of PC placements.[18] However, we did not find significant differences in serum albumin or hemoglobinbetween the two groups of the patients. Miller *et al*. ina study on 101 hemodialysis patients showed that AVFadequacy (defined as blood flow rate >350 ml/min) was notaffected by serum albumin.[19]

It should be mentioned that some complications mayoccur only in AVF patients including anastomotic pseudoaneurysm, a rare AVF complication that may leadto dysfunction, rupture or complicated by infection),skin necrosis due to frequent fistula puncturing that maybe complicated by severe or life-threatening bleeding,hand ischemia that may lead to gangrene of fingers, hyperdynamic syndrome due to significant increase blood flow through the fistula that can lead to heart failure, fistula stenosis that may require fistula angiography andrepair by angioplasty.[20,21]

We did not see any of theseserious events in the AVF group patients during this study. This study had certain limitations such as small samplesize and short duration of follow-up, and therefore it isrecommended to conduct similar studies with larger samplesize and longer duration of follow-up.

Conclusion

We found better dialysis adequacy in AVF group. We found that there were some advantages of AVF over PC, such as lower rate of infection and thrombosis, which have been reported in some studies. We recommend that AVF be created in all of patients with chronic kidney disease for better dialysis adequacy.

References

1. Lee T, Barker J, Allon M. Tunneled catheters in hemodialysis patients: Reasons and subsequent outcomes. Am J Kidney Dis 2005;46:501-8.
2. Vascular Access Work Group. Clinical practice guidelines for vascular access. Am J Kidney Dis 2006;48Suppl 1:S248-73.
3. Karkar A, Chaballout A, Ibrahim MH, Abdelrahman M, Al Shubaili M. Improving arteriovenous fistula rate: Effect on hemodialysis quality. HemodialInt 2014;18:516-21.
4. Fokou M, Teyang A, Ashuntantang G, Kaze F, Eyenga VC, Chichom Mefire A, *et al*. Complications of arteriovenous fistula for hemodialysis: An 8-year study. Ann VascSurg 2012;26:680-4.

5. Hirth RA, Turenne MN, Woods JD, Young EW, Port FK, Pauly MV, *et al*. Predictors of type of vascular access in hemodialysis patients. JAMA 1996;276:1303-8.
6. Ifudu O, Macey LJ, Homel P, Hyppolite JC, Hong J, Sumrani N, *et al*. Determinants of type of initial hemodialysis vascular access. Am J Nephrol 1997;17:425-7.
7. Coli' L, Cuna V, Capelli I, Kwin C, Donati G, La Manna G, *et al*. When native arteriovenous fi stula is not possible: The permanent catheter is better. G ItalNefrol 2009;26:154-7.
8. Allon M. Dialysis catheter-related bacteremia: Treatment andprophylaxis. Am J Kidney Dis 2004;44:779-91.
9. Moyano MJ, Salgueira M, Aresté N, Escalera B, del Toro N, Jiménez-Víbora E, *et al*. Comparative study of PTFE grafts in forearm vs cuffed permanent catheters. Nefrologia 2006;26:594-9.
10. Moist LM, Hemmelgarn BR, Lok CE. Relationship between blood flow in central venous catheters and hemodialysisadequacy. Clin J Am SocNephrol 2006;1:965-71.
11. Tonelli M, Muirhead N. Access type as a predictor ofdialysis adequacy in chronic hemodialysis patients. ASAIO J2000;46:279-82.
12. Hicks CW, Canner JK, Arhuidese I, Zarkowsky DS, Qazi U,Reifsnyder T, *et al*. Mortality benefits of different hemodialysisaccess types are age dependent. J VascSurg 2015;61:449-56.
13. Karkar A, Chaballout A, Ibrahim MH, Abdelrahman M,Al Shubaili M. Improving arteriovenous fi stula rate: Effect onhemodialysis quality. HemodialInt 2014;18:516-21.
14. Kukavica N, Resic H, Sahovic V. Comparison of complicationsand dialysis adequacy between temporary and permanenttunnelled catheter for haemodialysis. Bosn J Basic Med Sci2009;9:265-70.
15. Ethier J, Mendelssohn DC, Elder SJ, Hasegawa T, Akizawa T,Akiba T, *et al*. Vascular access use and outcomes: Aninternational perspective from the dialysis outcomes and practicepatterns study. Nephrol Dial Transplant 2008;23:3219-26.
16. Canaud B, Leray-Moragues H, Garrigues V, Mion C. Permanent twin catheter: A vascular access option of choice for haemodialysis in elderly patients. Nephrol Dial Transplant 1998;13Suppl 7:82-8.
17. Lee T, Barker J, Allon M. Comparison of survival of upper arm arteriovenous fistulas and grafts after failed forearm fi stula. J Am SocNephrol 2007;18:1936-41.
18. Banerjee T, Kim SJ, Astor B, Shafi T, Coresh J, Powe NR. Vascular access type, inflammatory markers, and mortality in incident hemodialysis patients: The choices for healthy outcomes in caring for end-stage renal disease (CHOICE) study. Am J Kidney Dis 2014;64:954-61.
19. Miller PE, Tolwani A, Luscy CP, Deierhoi MH, Bailey R, Redden DT, *et al*. Predictors of adequacy of arteriovenous fi stulas in hemodialysis patients. Kidney Int 1999;56:275-80.
20. Fokou M, Teyang A, Ashuntantang G, Kaze F, Eyenga VC, ChichomMefi re A, *et al*. Complications of arteriovenous fi stula for hemodialysis: An 8-year study. Ann VascSurg 2012;26:680-4.
21. Beigi AA, Sadeghi AM, Khosravi AR, Karami M, Masoudpour H. Effects of the arteriovenous fi stula on pulmonary artery pressure and cardiac output in patients withchronic renal failure. J Vasc Access 2009;10:160-6.